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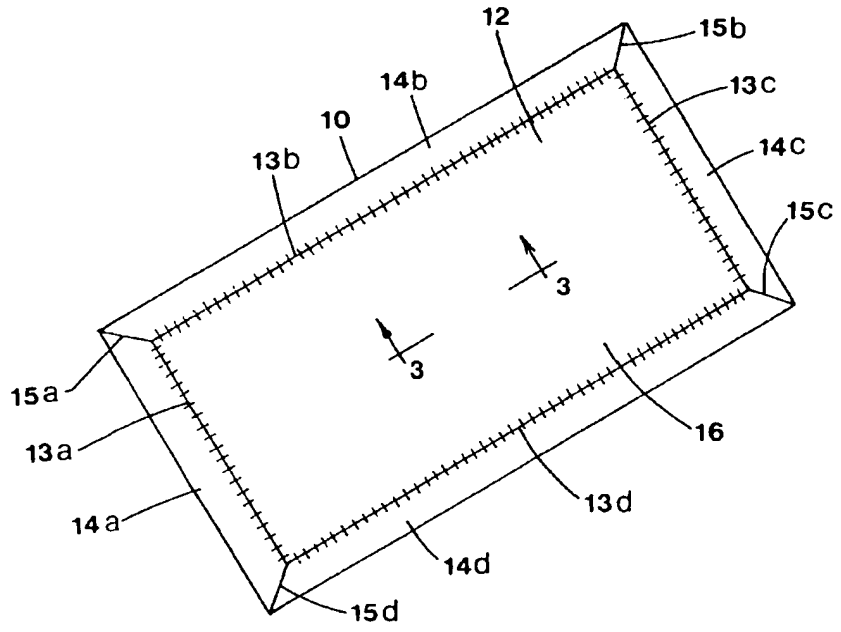
(54) Title: PROCESSING SUBSTRATE AND/OR SUPPORT SURFACE



(57) Abstract: A processing substrate comprises a first material having a liquid-permeable surface, a second material disposed adjacent to the first material and having a liquid-absorbent portion and a third material disposed adjacent the second material and having a liquid-impermeable surface.

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PROCESSING SUBSTRATE AND/OR SUPPORT SURFACE

Technical Field

The present invention relates generally to protective media, and, more particularly, to a processing substrate and/or support surface which is disposable.

Background Art

Management of bacteria, liquids, fats and other waste during the preparation and handling of foods is of concern in food handling areas. Typically, such areas include the kitchen, although modern lifestyles include out-of-home occasions such as social and recreational gatherings where food is prepared, transported and/or served outside of the kitchen. Foods of particular concern from the standpoint of possibility of food-borne illness are fish, fowl and ground meats; although all foods present some degree of risk. Current media articles discuss the fact that the common cutting boards used in the preparation of foods are a source of food contamination. Other commonly used food preparation surfaces, such as countertops, also present some risk. Specifically, it has been found that bacteria can become entrapped in surface imperfections of the cutting surface, resulting in a surface that is difficult, if not impossible, to clean and/or sterilize. The cutting surface thus becomes capable of transferring bacteria to other foods, which provides a favorable media for pathogens to proliferate, resulting in an increased potential for food-borne illness, particularly when contact is had with high-risk foods. In fact, some foods considered to be pathogenically low-risk, such as fresh fruits and vegetables can become contaminated, waiting for the right environment for the bacteria to proliferate. Illnesses from mild to severe or even fatal can result.

Another issue with cutting boards is the transfer of juices from the cutting board to other surfaces in the kitchen due to the fact that the cutting board is normally not designed to capture and contain juices during the cutting operation and thereafter through final

disposal. In addition to the inconvenience of having to clean the countertop or other surface(s) exposed to the juices, a possibility exists that other food items placed on such surface(s) may be cross-contaminated.

Products are in the marketplace today that attempt to address issues of liquid, fat, and bacteria management during cutting and general food preparation. However, these products fall short of optimum in one way or another. Specifically, they do not absorb, are not cut resistant, and/or fail to provide an effective bacteria barrier between the food being handled and the work surface. Also, bacteria are retained which can cause contamination during subsequent use.

In addition to the foregoing, most, if not all, food preparation surfaces lack one or more of the following attributes:

1. a single use, disposable cutting surface that is virtually cut resistant and also entraps and holds waste and bacteria;
2. a food preparation surface which prevents food movement during cutting;
3. a food preparation surface which prevents and/or selectively manages movement thereof on the counter top during cutting;
4. a single-use food preparation surface which is easily disposed of while securely containing contaminants; and
5. a single-use cutting surface that lays flat during use.

Coggins U. S. Patent No. 5,520,945 discloses a disposable sheet that may be used in food service applications to prevent the cross-contamination of foods and eliminate the need for time-consuming clean-ups. The sheet comprises a porous layer that allows materials such as oil or flour to pass through, an absorbent layer that holds the materials passing through the porous layer, and a barrier layer that ensures that the materials do not contaminate a food preparation surface. The sheet has multiple uses such as for rolling dough, absorbing excess moisture, making sandwiches, cutting breads and condiments, and drawing excess oil away from fried items. The disposable sheet is only disclosed for use with items that do not require aggressive cutting, and hence, is not adapted for use with items that require substantial cutting pressures, such as meats and hard vegetables.

Thompson U. S. Patent No. Re. 36,717 discloses a flexible preparation and transfer sheet. The sheet comprises a homogeneous structure of polypropylene, with a thickness in a range between 0.010 to 0.030 inch. The sheet may be flexed about a longitudinal

centerline whereupon the sheet material develops a cantilever beam strength sufficient to transport food articles after preparation to an appropriate container.

Wu et al. U. S. Patent No. 6,021,524 discloses a polymeric film having increased cut resistance. The film comprises a polymeric matrix having a plurality of cut resistance fibers dispersed therein. The film is preferably made into medical or industrial gloves.

PCT published application number WO 00/29209 discloses a flexible mat for absorbing liquids on floors or other surfaces. The mat includes a waterproof backing layer and a foam sheet formed by polymerization of a water-in-oil emulsion. The mat can optionally include a liquid pervious sheet and a non-skid material.

Summary of the Invention

In accordance with one aspect of the present invention, a processing substrate includes a sheet having a surface capable of withstanding cutting by a serrated knife without substantial compromise of the sheet, a liquid impervious barrier and a liquid absorbent portion disposed adjacent the surface.

According to a further aspect of the present invention, a processing substrate comprises first means for providing a liquid-permeable, cut resistant surface capable of withstanding cutting by a serrated knife without substantial compromise of the processing substrate, second means disposed adjacent the first providing means for providing a liquid-absorbent portion and third means disposed adjacent the second providing means for providing a liquid-impermeable portion.

According to a further alternative aspect of the present invention, a method of forming a cutting surface comprising the steps of providing a first material having a liquid-permeable, cut-resistant surface that can withstand cutting by a serrated knife without substantial compromise of the first material, providing a second material disposed adjacent the first material and having a liquid-absorbent portion and providing a third material disposed adjacent the second material and having a liquid-impermeable surface.

In accordance with yet another aspect of the present invention, a method of processing an item comprises the steps of providing a processing surface comprising a first material having a liquid-permeable, cut-resistant surface that can withstand cutting by a serrated knife without substantial compromise of the first material, a second material disposed adjacent the first material and having a liquid-absorbent portion and a third

material disposed adjacent the second material and having a liquid-impermeable surface, placing the item on the processing surface and processing the item while the item is on the processing surface. The item is then removed from the processing surface and the processing surface is disposed of.

Other aspects and advantages of the present invention will become apparent upon consideration of the following detailed description.

Brief Description of the Drawings

FIG. 1A comprises an isometric view of a processing substrate according to a one embodiment the present invention;

FIG. 1B comprises an isometric view of a processing substrate according to another embodiment of the present invention;

FIG. 2 comprises a side elevational view of the processing substrate of FIG. 1; and

FIG. 3 comprises a sectional view taken generally along the lines 3-3 of FIG. 1; and

FIG. 4 comprises a perspective view of apparatus for producing processing substrates as shown in FIGS. 1A.

Description of the Preferred Embodiments

Referring now to FIG. 1A, a processing substrate and/or support surface that may be used as a food preparation surface or sheet 10 according to the present invention preferably is planar (i.e., flat) in shape. Alternatively, as seen in FIGS. 1B and 2, the sheet 10 may be tray-shaped and includes a substantially planar central portion or base 12 and inclined or curved side surfaces 14a-14d, wherein the base 12 and side surfaces 14 together define a generally concave structure. The side surfaces 14 may be formed by folding and/or scoring the sheet 10 at corner portions 15a-15d and optionally folding or scoring the sheet 10 at portions 13a-13d intermediate the base 12 and side surfaces 14. The inclined or curved side surfaces 14 could alternatively be formed by any other process, such as forming through the application of heat, vacuum forming, vacuum pressure forming, or the like. If desired, fewer than four inclined side surfaces 14 may be provided. For example, only the inclined side surfaces 14a-14c may be employed to

provide a flat edge surface that may be oriented toward the user so that an inclined side surface does not interfere with the user's hands or arms. Preferably, although not necessarily, the sheet 10 is intended for one time use as a cutting surface or as a sheet supporting an article or as a barrier for isolating an article resting on a surface (for example, a plant on a shelf, an article of food on a counter or in a microwave, or the like), or as a food preparation and bacteria management sheet. Following the use the sheet 10 and any waste products and contaminants carried thereby may be disposed of in any suitable fashion. The concave or tray-shaped structure (if used) facilitates retention of the waste products and contaminants during the food preparation, transport and/or disposal processes. Additionally or alternatively, the sheet 10 may be sufficiently flexible to allow the user to bend and/or fold the sheet 10 to prevent escape of waste products and contaminants therefrom during disposal.

Referring also to FIG. 3, according to one embodiment of the present invention, the sheet 10 also includes a cut-resistant, liquid-permeable top or upper portion or layer 16, which substantially prevents the integrity of the sheet 10 as a whole (and, in particular, the layer 16) from being compromised during cutting while at the same time allowing passage of juices and liquids through the layer 16. Preferably, the upper portion or layer 16 is made of a material sufficiently durable to withstand aggressive cutting of meats, vegetables and other food items by a serrated or non-serrated blade, particularly in the situation where a cutting motion is applied to meats, poultry or fish (or any other fibrous protein material) that results in the application of cutting force components in multiple directions to the item. A serrated blade presents a series of equally or non equally spaced points or tips to the upper surface of the layer 16 that can snag or otherwise catch on edges of the material used for the top layer 16. Because of this it is generally preferred (although not necessarily the case) that the top layer 16 have irregularly or randomly spaced openings therein that prevent any points or tips from contacting material below the layer 16 during cutting. In this way, the possibility that the integrity of the sheet 10 would be compromised is reduced.

In addition to the foregoing, the upper portion or layer 16 preferably has an upper surface 17 that is textured or otherwise formed to prevent slippage of items thereon during processing.

The sheet 10 further includes a middle or intermediate portion or layer 18 that may be made of a liquid absorbent material that retains the juices and liquids passed by the upper layer 16, as well as a bottom portion or layer 20, which is preferably made of a slip-

resistant, liquid and bacteria impervious material to prevent slipping of the sheet 10 and leakage of liquids and transfer of bacteria onto or from a work surface (such as a countertop, a cutting board, or the like) during use.

The upper layer 16 may be of a length and width substantially equal to the length and width of the middle layer 18. Alternatively, the upper layer may be of a smaller size than the size of the layer 18, thereby providing a cutting surface that is partially or fully surrounded by portions of the middle layer 18. As a further alternative, the top and bottom layers 16, 20 may be of the same size and the middle layer may be of a smaller size and so arranged relative to the layers 16 and 20 such that the middle layer 18 is surrounded by the joined outer margins of the layers 16 and 20.

If desired, the sheet 10 may instead include a different number of layers or portions each imparting one or more desired characteristic(s) to the sheet 10. In addition, the sheet 10 may comprise a single layer or portion or multiple layers or portions wherein each layer or portion is made of material that is differentially treated during production to obtain multiple desired characteristics. Still further, the sheet 10 may include one or more layers or portions that are not differentially treated during production in combination with one or more layers that are differentially treated during production. For example, the sheet 10 could comprise a single layer that is liquid absorbent, but which has a first surface that is treated (by any suitable process, such as the application of heat or a chemical additive) during production to produce a cut-resistant, liquid-permeable surface. The sheet 10 may further have a second surface opposite the first surface that may be treated by any suitable process (for example, as noted above) during production to produce a slip-resistant barrier surface. Alternatively, the sheet 10 could comprise two layers, a first of which provides a slip-resistant barrier surface, and a second of which provides a cut-resistant surface. In this case, the liquid absorbent layer may be omitted, or the liquid-absorbent material may be provided as part of one of the first or second layers or as a separate layer. Still further, the slip-resistant surface and/or the cut-resistant, liquid-permeable surface could be omitted, if desired.

The various layers 16, 18 and 20 are secured or formed together in any suitable fashion taking the various materials of the layers into account. For example, two or more of the layers 16, 18 and 20 may be heated to fuse the layers together or the layers may be laminated as part of an extrusion process. Two or more of the layers could instead be secured together by an adhesive including a hot melt adhesive as well as a solvent or water based adhesive, as long as the adhesive is approved for food contact and compatible with

the layers. Alternatively, two or more of the layers 16, 18 and 20 may be formed using materials and/or a manufacturing process which result in simultaneous formation and bonding of such layers. Still further, the layer 16 may be bonded or otherwise secured to the layer 20 at selected locations, thereby capturing the layer 18 therebetween. In this case, the layer 18 may have one or more voids therein to facilitate the joinder of the layers 16 and 20 at the location(s) of the void(s). Still further, the layer 18 may be omitted and the layers 16 and 20 may be joined at spaced locations to create voids between the layers 16, 20 which serve to attract and retain liquid(s) therein by capillary action.

FIG. 4 illustrates apparatus that may be used to produce a number of cutting surfaces as shown in FIG. 1A. An extrusion die or other delivery device 40 deposits thin streams of molten thermoplastic onto a web 42 of liquid-absorbent material, such as cellulosic tissue or batting. The material deposited on the web 42 is chosen from but not limited to polyolefins, such as polyethylene (PE) or polypropylene (PP), polyester, such as polyethylene terephthalate (PET), polystyrene (PS), polyvinyl alcohol (PVA), polyvinyl chloride (PVC), nylon (such as nylon 6 or nylon 66), polyacrylonitrile (PAN), ABS, ethylene-vinyl acetate (EVA) copolymer, multi layers of the same or different polymers, blends and recycled polymers (including polymers that are cured by ultraviolet or visible light, an electron beam, water or other curing agent). Addition of one or more filler(s) may be advantageous both from a cost advantage as well as improvement of modulus, heat distortion and cut resistance. Preferably, each stream is approximately on the order of 1-100 thousandths inch wide and are deposited at equally-spaced locations on the web 42 approximately 1-500 thousandths inch apart. Alternatively, the streams may be deposited at non equally spaced locations on the web 42 and/or may be of differing widths and/or may be deposited at different points of time. Still further, different stream shapes (e.g., a wavy, curved, discontinuous or interrupted stream as opposed to the linear continuous stream extent described above and/or a different cross-sectional shape) and/or different materials could be sequentially deposited on the web 42. In other words, a single stream may comprise a first portion of a first material, a second portion deposited after the first portion of a second material, a third portion deposited after the second portion of a third material or the first material, etc... In an alternative embodiment, adjacent streams may be of differing materials. In a general sense, N different materials may be deposited or otherwise formed *in situ* on the web 42 in a repeating or non-repeating sequence or pattern or in a random fashion. In the case of a repeating sequence or pattern, the repetition frequency may be established at a value less than or equal to N. In any event, the choice

of materials, sequence or pattern, and the like affect the physical characteristics of the resulting surface.

If the upper layer 16 is to be smaller than the size of the layer 18, then the streams are deposited only on a center portion of the web 42. In addition, the flow of thermoplastic resin is periodically interrupted so that discrete portions of web are formed having thermoplastic thereon wherein such portions are separated by further web portions not having thermoplastic deposited thereon. The web 42 then passes between a pair of rolls 44a, 44b. Preferably, the roll 44a is smooth and the roll 44b has a plurality of diamond-shaped or other shaped protrusions 46 on the surface thereof. The protrusions 46 deform and spread out the still molten thermoplastic streams to transform the linear streams into a desired two or three dimensional pattern of thermoplastic resin on the web 42. The web 42 then passes between one or more additional pairs of rolls 48 that further spread out and/or flatten the thermoplastic streams and impart a desired texture thereto. The resulting surface provides cut resistance and prevents food from sliding thereon

If desired, any pattern can be created on the web 42, for example, a random pattern or a criss-cross pattern could be created by drizzling, spraying or otherwise applying the material thereto.

Thereafter, the web 42 is inverted (i.e., turned over) and the layer 20 is formed *in* situ by lamination or other delivery of a thermoplastic or other material onto an undersurface 50 by an extrusion die or other delivery apparatus. The layer 20 may alternatively be formed without first inverting the web 42 by any suitable process. The layer 20 may be formed of any of the materials described above in connection with the layer 16 including polyolefins such as PE or PP, polyesters such as PET, PS, PVA, PVC, nylon, PAN, ABS, EVA, etc... In alternative embodiments, 20 a suitable coating material may be applied by a sprayer and mechanically processed by a doctor blade or a portion of the material of the layer 18 may be melted or otherwise differentially processed as noted above so that a sealed portion is obtained (if the material of the layer 18 so permits). Still further, a barrier layer of Tyvek® (sold by E. I. Du Pont de Nemours and Company of Wilmington, Delaware) may alternatively be secured to the underside of the web 42 by any suitable means.

The layer 20 may be formed with a pattern or texture by embossing and/or may be coated or laminated or otherwise formed with a slip-controlling (such as slip resistant) or adhesive material. The slip control may be provided by a continuous or discontinuous surface of the layer 20, as desired. The resulting coated web is then cut at appropriate

locations to form the cutting sheets. Alternatively, if desired, the product may be delivered to the consumer in roll form so that the consumer may cut the product to a desired length and/or shape using a cutter bar, scissors or knife. Still further, the product may be delivered in roll form with perforations that allow the consumer to tear off sheets as needed.

The present invention is not limited to the concept of utilizing disposable, absorbent barrier surfaces in place of conventional cutting boards, but encompasses all food handling and article support occasions where absorbent, liquid/bacteria barrier management is desirable. The present invention comprehends arrangements of various barrier, absorbent and cut/physical abuse resistant mechanisms for the management by containment or isolation of wastes and bacteria encountered during food processing, such as cutting, draining and accumulating (staging). All of these processes involve the use of a generally horizontal work surface, where the present invention may be advantageously employed. In general, the invention comprehends the use of N layers or other portions which may be arranged in a suitable or desired fashion to obtain the desired mechanical, absorbent, barrier and/or other characteristics.

The preferred embodiment utilizes the cut resistant layer 16 as the top layer, where the cutting operation is performed. If desired, the layer 16 may be omitted and the cut-resistant surface could instead be provided as part of the bottom layer 20. In this case the cut-resistant surface would need to be impervious to liquid and the material of the middle layer 18 could be exposed directly to the item being cut. This alternative may result in the possibility of material transfer from the layer 18 to the food, although such possibility can be minimized through careful control of materials and design. For example, in an embodiment where the liquid absorbent layer 18 is the top layer, effort should be made to ensure minimum transfer of material (e.g., fibers) to the food being cut. In the case of paper, woven or nonwoven fabrics as the material of the liquid absorbent layer 18, thermal bonding of fiber to fiber in such layer and/or fiber of such layer to the material of the bottom layer 20 significantly reduces fiber transfer to the food. Many other commercially available techniques for minimizing transfer of material(s) exist. For example, various thermal embossing patterns could be used. Care should be taken to ensure that the absorptive capacity of the material of the layer 18 is minimally affected by the mode of bonding.

Other arrangements can be envisioned, such as thermoplastic/cellulosic conglomerates or agglomerates. In these arrangements thermoplastic and cellulosic

absorptive materials are compressed together or otherwise processed and/or combined to form a cut resistant, absorptive sheet. When a thermoplastic liquid barrier component is fused on one side, a cut resistant, absorptive, barrier system is formed.

Still further, each layer or portion may be "tuned" (in other words, the material selection, properties and/or amounts may be controlled) to obtain the desired attributes and properties for each. For example, a first sheet could be designed for cutting chicken comprising an upper layer of PE or PP, a middle layer of cellulosic absorbent material and a barrier layer of polymeric material as described above in connection with FIG. 4. A second sheet could alternatively be envisioned for light food preparation (such as assembling sandwiches from pre-cut foods) including the same three layers in different proportions. This might comprise an upper layer of PE or PP having a thickness substantially less than the thickness of the upper layer of the first sheet, a middle layer of cellulosic absorbent material identical to the material of the middle layer of the first sheet and a barrier layer of polymeric material identical to the material of the barrier layer of the first sheet. The thicknesses of the middle and barrier layers of the second sheet may be different than or identical to the thicknesses of the same layers of the first sheet. This provides a sheet having lesser cut resistance than the first sheet, but still provides a sheet having the desired absorbency and barrier
characteristics appropriate to the intended application for the sheet. Still further, the celluosic material of the middle layer might be replaced by a more oliophilic material, such as nonwoven polypropylene or the same or a different cellulosic material that has been treated to increase the oliophilic properties thereof, to form a sheet for managing oil during food preparation.

The present invention provides a processing and/or support surface that retains liquids yet is convenient and space effective for easy disposal. The product may be pre-treated for packaging purposes and/or to allow easy and convenient disposal. Examples of pretreatment for easy disposal include pleating, folding, scoring, forming and the like.

As noted above, the cut resistant top layer 16 may be made from a random or regular pattern of thermally formable material or coating materials. In addition to the examples given above, the material of the layer 16 may comprise latexes, epoxies, paper coating and a contact drum print that is treated by a doctor blade. Still further, a continuous sheet of polymer film could alternatively be used in place of the cut-resistant upper layer described in conjunction with FIG. 4 wherein the film is perforated by any suitable process, such as vacuum, needle or water jet perforating, laser, hot pins or

mechanical punching to create holes for the passage of liquid therethrough. A minimum hole diameter of 0.007 to 0.250 thousandths inch is preferred with 1/32 to 1/8 inch most preferred. Between 5 and 25 holes/square inch (depending upon hole size(s)) is preferred. The spacing between the tips of serrated knife blades vary; however, the smaller the hole diameter the less the chance that a tip of such a blade will catch on an edge of a hole. The film can be made of virgin polymer or blends of virgin and recycled materials or from recycled materials alone. As noted above, fillers or pigments to increase opacity, optimize desired properties, and/or reduce cost are options. Alternatively, porosity can be achieved using different processes such as pre- or post-lamination, lost mass process, leaching or scavenging.

The cut resistant layer 16 can alternatively comprise other cut resistant structures, such as netting, fabrics or scrims, so long as the layer allows easy passage of juices and other liquids through to the absorbent layer 18. In each embodiment the minimum thickness for the layer 16 is approximately 5 mils for unfilled materials, but it may be possible to achieve adequate cut resistance with thinner arrangements.

Care should be taken to use food contact approved materials. The use of a discontinuous layer affords a cut resistant barrier that keeps the material of the layer 18 from the surface of the item being cut. Also, the discontinuous layer lends itself to being easily disposed of due to ease of "wadding" by the user

The liquid-absorbent layer 18 preferably is an absorbent structure selected from, but not limited to: non-woven fabrics of synthetic polymers or blends of fibers; laminates of various fabrics or combination of fabrics; cellulosic material(s), meltblown and spunbonded nonwoven fabrics, woven fabrics, multiple layers and combinations of fabrics and papers, adsorbent powders like polyacrylic acid polymers, open-celled foams, perforated closed cell foams and/or blends of polymer and cellulosic materials. The layer 18 could alternatively comprise any other suitably absorbent commercially available materials.

If a synthetic polymer fabric, woven or nonwoven, is used for the layer 18, a food-contact approved wetting agent or other surface additive may be required to ensure water wettability of the fabric. Typical levels are < 1% by weight of the fabric. Some hydrophilic fibers can be used for layer 18 in blends with synthetic polymers to eliminate the need for surfactants. Examples of these hydrophilic fibers are cellulose, rayon and PVA; however, the present invention is not limited to these hydrophilic fibers. In some cases lamination of two different fabrics may be necessary to obtain sufficient hydrophilic

properties. However, it is preferred in this example to use a blend of fibers in one fabric. Typically, a minimum of 5 to 10% hydrophilic fiber is needed in a fiber blend to ensure that the fabric has sufficient hydrophilic properties. An additional benefit of using fiber blends in the layer 18 is the possibility to use different polymers in the layer 16 and still employ thermal bonding of the layers.

The bottom layer 20 forms a barrier to prevent liquids from the absorbent layer from passing through to the surface of the counter top or other support surface. The bottom layer 20 also blocks the transfer of bacteria between the layers 16 and 18 and the surface supporting the sheet 10. The bottom layer 20 can be any substrate material that prevents passage of liquid therethrough. For example, the layer 20 may comprise a continuous sheet of PP or PE film (or any other polymer film, such as those noted above) having a thickness on the order of 0.25–5.0 mils, although a different thickness could be used instead. Fillers and/or coloring agents or other additives can be utilized to obtain the desired characteristics, color and/or opacity. Like the layer 16, the film can be made of virgin polymer or blends of virgin and recycled materials or from recycled materials alone. Typically, the layer 20 is fabricated of materials chosen from a group of materials that will thermally bond to the layer adjacent thereto (in the preferred embodiment the layer 18), thereby obviating the need for adhesives, which are costly and can adversely affect the desired characteristic (e.g., the absorbent nature) of the adjacent layer.

In summary, the present invention comprehends any structure (single layer or multilayer, conglomerates, agglomerates, foams, product suspended in one or more matrices or suspensions) having cut resistant properties, liquid-absorbent properties and/or barrier properties. The properties may be afforded by any suitable processing technique(s), such as coating or other application of product, denaturing or other change in a material (whether by flame treating or other application of heat, chemicals, irradiation, UV, IR or visible light, etc...), mechanical or electrical processing, or the like. In addition, the various materials may be selected from ecologically advantageous materials that biodegrade.

In the case of foams, these can be either of the open-cell or closed cell type made from conventional polyolefins or polyolefin filled materials. Still further, a foam can be filled with combinations of any of the non-conventional materials listed below, such as egg whites and shells or other foams could be used with fillers like mica, starch, wood flour, calcium carbonate and flax. Other suitable materials may be bread impregnated with adhesive binders, foamed potato starch or polyvinyl acetate with any number of

fillers like ground bone, lime or talc. Other suitable foams are polyvinylpyrollidone aggregate open cell foams and PE and PP aggregate foams. Such combined materials can provide cut resistance and/or liquid absorption properties.

Hollow fibers could also be employed. In this case, hollow fibers of a critical diameter may be used to suck up and retain water by capillary action. These fibers could possess cut resistant properties as well as liquid management properties and a barrier layer could be secured by any suitable means to a mat of such fibers to obtain a processing surface according to the present invention.

The following materials possess one or more of the above absorptive properties, cut resistance properties and barrier properties effective to manage bacteria or liquids during the preparation of food. Accordingly, any of these materials can be used in the present invention. Some are very eco-effective in that they decompose directly to food for biocycles and many do not absorb microwave energy and are safe for use as a support surface in microwave ovens:

"Earth shell " (a composition of potato starch and lime manufactured and/or sold by E. Khashoggi Industries, LLC of Santa Barbara, CA);

clay or clay-filled materials optionally reinforced with materials such as ground corncobs, silica, irradiated waste sludge or woven straw;

kelp and other marine vegetation;

ground marine shells (e.g., lobster, crab, shrimp or any other exoskeletal creatures, oyster, clam, scallop or zebra mussel shells) held together by a binder or matrix of any suitable material, such as barnacle adhesive;

cork;

wood or wood product derivatives and veneers;

natural fibers like cotton or wool either woven or in non woven batts;

materials such as flour, silica, rice, rice kernel, rice germ or starch of any kind (e.g., corn or potato starch) either alone or held together by a binder such as polyvinyl acetate or held together as conglomerate or agglomerate systems by any appropriate material(s);

animal, insect and/or fish products including shells, skins, hides, hooves, glues made from hides or hooves, scales or bones;

other protein glues or glues from other products (such as gluten);

egg white or egg yolk composites with flour, rice, egg shells, flours with yeast, corn starch or potato starch;

lecithin;

polymeric substances created from high temperature treatment, or other breakdown, of carbon chains predominantly in sugars and oils, such as is found in apples, grapes, cherries or other fruit (skins and/or pulp) olives (skins and/or pulp), olive oil, corn oil, vegetable oil, canola oil, or eggs;

bioengineered cell growth materials;

grasses and other terrestrial vegetation;

bark;

nonwoven microfibers;

cellular absorption swellable materials (such as Drytech® sold by The Dow Chemical Company of Midland, Michigan);

molecular sieve materials (e.g., a desiccant); and

hydrophilic powders, like polyacrylic acid or the like.

Further specific examples of structures according to the present invention are given below:

Example 1 - a trilayer structure wherein the layer 16 comprises 5 mil thick PP, filled with up to 40% mica and including 1/32" diameter holes with 9 holes/square inch. The layer 18 is a 37# airlaid cellulose mat thermally laminated to a 5 mil thick PP backing sheet comprising layer 20. The layer 16 is thermally bonded to the layer 18.

Example 2 - a bilayer structure comprising a nonwoven polyolefin fabric upper layer point bonded to a second layer of polymeric film that functions both as a barrier and as a cut resistant surface. During manufacture a food-contact approved surfactant may be applied to the upper layer to provide a desired hydrophilic characteristic.

Example 3 – a scrim made of any of a variety of materials, such as a thermoplastic or thermosetting polymeric material having voids between portions of material is post-filled with absorbent material, such as cellulose, using any suitable post-filling process, such as a wet-laid process or a vacuum process, to form a mat. A barrier layer of any suitable material (e.g., PP or PE) is thereafter applied in any suitable manner, such as by extrusion lamination, to an undersurface of the mat and the mat is thereafter subjected to

an embossing process either while the barrier layer is still partially molten and/or as heat is applied to cause the barrier layer to bond securely to the scrim.

The present invention can provide one or more of the following benefits, depending upon the choice of material(s), properties and material amounts:

1. the sheet absorbs food juices while cutting and reduces resulting mess;

2. the sheet is easy to dispose of;

3. the sheet reduces or even prevents accidental germ/microbial contamination because the germs from one food item will not get transferred to another if the cutting sheet is disposed of after use;

4. the sheet provides cut resistance, i.e., it helps reduce any cut damage to the kitchen or other work surface;

5. the sheet does not allow food juices to run all over the work surface;

6. the sheets may be provided in varying sizes to suit the cutting or other task;

7. the sheet may be used on top of a cutting board or directly on the work surface;

8. the sheet reduces slippage, by providing a skid-resistant contact with the work surface;

9. after cutting, one need only lift the sides of the sheet to funnel food into a cooking pot;

10. the sheet can be set on a surface to catch debris and grease;

11. the sheet is easily rolled up with waste captured therein and disposed of in the trash can;

12. since each sheet is clean the need for repeated cleaning of the cutting board or other work surface is avoided;

13. the sheet can be used to cut or process any food or other material including meat, chicken, fish, soft or hard fruits and vegetables, dough, etc...;

14. unlike using a paper towel, the sheet does not permit fiber and lint to become attached to the food being cut.;

15. the sheet does not transfer any smell or taste to the product being cut or otherwise processed (alternatively, the sheet could be impregnated with a desirable scent, such as lemon, which is then transferred to the item being processed);

16 the sheet manages bacteria by absorption, containment and barrier rather than by the use of added chemicals;

17. the sheet can be made food contact approved;

18. the top surface reduces slippage of food while cutting;

19. the cutting surface will not dull knives like some hard cutting surfaces;

20. the sheet is hygienic;

21. the sheet may be formed with at least one and, preferably multiple absorbent edges that give an extra measure of security to manage bacteria-borne juices;

22. the sheet offers superior food/surface protection for non-cutting food preparation applications;

23. the sheet affords an easy, convenient medium for in-home or out-of-home, recreational and outdoor uses;

24. the sheet can be cut by consumers to other sizes and/or shapes;

25. the sheet can be held in place on countertops by a few drops of water;

26 the sheet protects the countertop and food from potentially deadly pathogens that cannot be seen;

27 the sheet allows safer food preparation for the consumer and the consumer's family by reducing the risk of food-borne illness;

28. the sheet can reduce food preparation time;

29 the profile and/or texture of the cutting surface can be customized to provide benefits not practical in conventional cutting surfaces or boards simply because such articles would be difficult or impossible to wash;

30 the sheets do not take up room in the dishwasher or in the bags and wraps drawer of the kitchen;

31. in alternative embodiments bacteria borne liquids are securely trapped in cells and/or a layer below the cutting surface;

32. the sheet may be constructed so that the consumer can see the absorption of liquid;

33. the sheet may be made to have a clean hygenic appearance;

34. the sheet may have a decorative appearance that is printed and/or embossed as desired;

35. the sheet absorbs like a paper towel, but has the additional advantages of barrier and cut resistance;

36. the sheet has additional uses, for example, as a placemat, as counter protection for use around stove/cook top, bin/shelf protection in refrigerator, under dog or cat dish, under plants, under large serving dishes, etc...;

37. in some embodiments the sheet has a place to wipe a knife on;

38. the sheet can make a desirable addition to a picnic basket;

39 the sheet can be used to line a refrigerator meat tray;

40 the sheet absorbs and contains all juices from defrosting meat;

41. the sheet can contain odors from foods, such as fish;

42 the sheet can be used on dishes and platters to prevent scratching of same by knives;

43. the sheet can be placed under sticky and dripping containers in refrigerator ;

44. the sheet does not fall apart like paper towels; and

45. the sheet could be used as a drawer liner or as a mat to do art projects on.

Numerous modifications to the present invention will be apparent to those skilled in the art in view of the foregoing description. Accordingly, this description is to be construed as illustrative only and is presented for the purpose of enabling those skilled in the art to make and use the invention and to teach the best mode of carrying out same. The exclusive rights to all modifications which come within the scope of the appended claims are reserved.

Industrial Applicability

The present invention is not limited to the concept of utilizing disposable, absorbent barrier surfaces in place of and/or in conjunction with conventional cutting boards, but encompasses all food handling, article support and barrier/isolation applications where absorbent, liquid/bacteria barrier management is desirable.

Claims

We claim:

1. A single use processing substrate, comprising:
providing a surface capable of withstanding cutting by a serrated knife without substantial compromise of the sheet, a liquid impervious barrier and a liquid absorbent portion disposed adjacent the surface.

2. The processing substrate of claim 1, wherein the liquid absorbent portion is disposed between the surface and the liquid impervious barrier.

3. The processing substrate of claim 2, wherein the surface is formed by a layer of thermoplastic resin.

4. The processing substrate of claim 3, wherein the layer of thermoplastic resin comprises a discontinuous pattern of material.

5. The processing substrate of claim 4, wherein the thermoplastic resin is selected from the group consisting of polyolefins, polyesters, polystyrene, polyvinyl alcohol, polyvinyl chloride, nylon, polyacrylonitrile, ABS and ethylvinylacetate.

6. The processing substrate of claim 3, wherein the layer of thermoplastic resin comprises a continuous film of material having holes formed therein.

7. The processing substrate of claim 6, wherein the holes in the continuous film are formed by punching.

8. The processing substrate of claim 6, wherein the holes in the continuous film are formed by perforating.

9. The processing substrate of claim 1, wherein the liquid absorbent portion comprises cellulosic material.

10. The processing substrate of claim 9, wherein the cellulosic material comprises tissue.

11. The processing substrate of claim 1, wherein the liquid impervious barrier is formed by a layer of thermoplastic resin.

12. The processing substrate of claim 11, wherein the layer of thermoplastic resin comprises a continuous sheet of material.

13. The processing substrate of claim 12, wherein the thermoplastic resin is selected from the group consisting of polyolefins, polyesters, polystyrene, polyvinyl alcohol, polyvinyl chloride, nylon, polyacrylonitrile, ABS and ethylvinylacetate.

14. A single use processing substrate, comprising:
a cut-resistant surface comprising a continuous film having holes formed therein, a liquid absorbent portion disposed adjacent the cut-resistant surface and a liquid impervious barrier surface opposite the cut-resistant surface.

15. The processing substrate of claim 14, wherein the liquid absorbent portion is disposed between the cut-resistant and barrier surfaces.

16. The processing substrate of claim 14, wherein the cut-resistant surface is formed by a layer of thermoplastic resin.

17. The processing substrate of claim 16, wherein the thermoplastic resin is selected from the group consisting of polyolefins, polyesters, polystyrene, polyvinyl alcohol, polyvinyl chloride, nylon, polyacrylonitrile, ABS and ethylvinylacetate.

18. The processing substrate of claim 14, wherein the holes in the continuous film are formed by punching.

19. The processing substrate of claim 14, wherein the holes in the continuous film are formed by perforating.

20. The processing substrate of claim 14, wherein the liquid absorbent portion comprises cellulosic material.

21. The processing substrate of claim 20, wherein the cellulosic material comprises tissue.

22. The processing substrate of claim 14, wherein the barrier surface is formed by a layer of thermoplastic resin.

23. The processing substrate of claim 22, wherein the layer of thermoplastic resin comprises a continuous sheet of material.

24. The processing substrate of claim 23, wherein the thermoplastic resin is selected from the group consisting of polyolefins, polyesters, polystyrene, polyvinyl alcohol, polyvinyl chloride, nylon, polyacrylonitrile, ABS and ethylvinylacetate.

25. A disposable processing substrate, comprising:
a first material having a liquid-permeable, cut resistant surface capable of withstanding cutting by a serrated knife without substantial compromise of the first material;
a second material disposed adjacent the first material and having a liquid-absorbent portion; and
a third material disposed adjacent the second material and having a liquid-impermeable portion.

26. The processing substrate of claim 25, wherein the first and third materials comprise layers of thermoplastic resin.

27. The processing substrate of claim 25, wherein the first, second and third materials form first, second and third layers, respectively.

28. The processing substrate of claim 25, wherein the first material is formed by a layer of thermoplastic resin.

29. The processing substrate of claim 28, wherein the layer of thermoplastic resin comprises a discontinuous pattern of material.

30. The processing substrate of claim 29, wherein the thermoplastic resin is selected from the group consisting of polyolefins, polyesters, polystyrene, polyvinyl alcohol, polyvinyl chloride, nylon, polyacrylonitrile, ABS and ethylvinylacetate.

31. The processing substrate of claim 28, wherein the layer of thermoplastic resin comprises a continuous film of material having holes formed therein.

32. The processing substrate of claim 31, wherein the holes in the continuous film are formed by punching.

33. The processing substrate of claim 31, wherein the holes in the continuous film are formed by perforating.

34. The processing substrate of claim 27, wherein the second material comprises cellulosic material.

35. The processing substrate of claim 34, wherein the cellulosic material comprises tissue.

36. The processing substrate of claim 27, wherein the third material comprises a layer of thermoplastic resin.

37. The processing substrate of claim 36, wherein the layer of thermoplastic resin comprises a continuous sheet of material.

38. The processing substrate of claim 37, wherein the thermoplastic resin is selected from the group consisting of polyolefins, polyesters, polystyrene, polyvinyl alcohol, polyvinyl chloride, nylon, polyacrylonitrile, ABS and ethylvinylacetate.

39. A single-use processing substrate, comprising:

first means for providing a liquid-permeable, cut resistant surface capable of withstanding cutting by a serrated knife without substantial compromise of the processing substrate;

second means disposed adjacent the first providing means for providing a liquid-absorbent portion; and

third means disposed adjacent the second providing means for providing a liquid-impermeable portion.

40. The processing substrate of claim 39, wherein the first means comprises a layer of thermoplastic resin.

41. The processing substrate of claim 40, wherein the layer of thermoplastic resin comprises a discontinuous pattern of material.

42. The processing substrate of claim 41, wherein the thermoplastic resin is selected from the group consisting of polyolefins, polyesters, polystyrene, polyvinyl alcohol, polyvinyl chloride, nylon, polyacrylonitrile, ABS and ethylvinylacetate.

43. The processing substrate of claim 39, wherein the layer of thermoplastic resin comprises a continuous film of material having holes formed therein.

44. The processing substrate of claim 43, wherein the holes in the continuous film are formed by punching.

45. The processing substrate of claim 43, wherein the holes in the continuous film are formed by perforating.

46. The processing substrate of claim 39, wherein the second means comprises cellulosic material.

47. The processing substrate of claim 46, wherein the cellulosic material comprises tissue.

48. The processing substrate of claim 39, wherein the third means comprises a layer of thermoplastic resin.

49. The processing substrate of claim 48, wherein the layer of thermoplastic resin comprises a continuous sheet of material.

50. The processing substrate of claim 49, wherein the thermoplastic resin is selected from the group consisting of polyolefins, polyesters, polystyrene, polyvinyl alcohol, polyvinyl chloride, nylon, polyacrylonitrile, ABS and ethylvinylacetate.

51. A method of forming a disposable cutting surface, the method comprising the steps of:

providing a first material having a liquid-permeable, cut-resistant surface that can withstand cutting by a serrated knife without substantial compromise of the first material;

providing a second material disposed adjacent the first material and having a liquid-absorbent portion; and

providing a third material disposed adjacent the second material and having a liquid-impermeable surface.

52. The method of claim 51, wherein the step of providing a first material comprises the step of forming a first thermoplastic layer.

53. The method of claim 52, wherein the step of providing a second material comprises the step of providing a cellulosic material.

54. The method of claim 53, wherein the step of providing a third material comprises the step of forming a second thermoplastic layer.

55. The method of claim 52, wherein the step of forming the first thermoplastic layer comprises the steps of extruding streams of thermoplastic onto a web of the cellulosic material and deforming the streams of thermoplastic.

56. The method of claim 55, wherein the step of deforming the streams of thermoplastic comprises the step of contacting the streams with at least one roll.

57. The method of claim 56, wherein the roll has a plurality of protrusions thereon that spread the streams of thermoplastic.

58. The method of claim 57, wherein the protrusions are diamond-shaped.

59. A method of making a disposable cutting sheet, the method comprising the steps of:

providing a web of liquid absorbent material;

depositing a first material onto a first side of the web to form a cut-resistant surface *in* situ on the web; and

depositing a second material on a second side of the web to form a barrier surface.

60. The method of claim 59, including the further step of deforming the first material after depositing of such material on the web.

61. The method of claim 60, wherein the step of deforming comprises the step of passing the web through rolls.

62. The method of claim 61, wherein one of the rolls includes protrusions on a surface thereof.

63. The method of claim 59, wherein the step of depositing the first material comprises the step of extruding molten thermoplastic onto the web.

64. The method of claim 63, wherein the thermoplastic is selected from the group consisting of polyolefins, polyesters, polystyrene, polyvinyl alcohol, polyvinyl chloride, nylon, polyacrylonitrile, ABS and ethylvinylacetate.

65. The method of claim 59, wherein the step of depositing the second material comprises the step of extruding molten thermoplastic onto the web.

66. The method of claim 65, wherein the thermoplastic is selected from the group consisting of polyolefins, polyesters, polystyrene, polyvinyl alcohol, polyvinyl chloride, nylon, polyacrylonitrile, ABS and ethylvinylacetate.

67. The method of claim 59, wherein the web comprises cellulosic material.

68. The method of claim 59, further including the step of cutting the web after depositing the second material onto the web.

69. A method of processing a fibrous protein material, the method comprising the steps of:

providing a single-use processing surface comprising a first material having a liquid-permeable, cut-resistant surface, a second material disposed adjacent the first material and having a liquid-absorbent portion and a third material disposed adjacent the second material and having a liquid-impermeable surface;

placing the fibrous protein material on the processing surface;

cutting the fibrous protein material while such material is on the processing surface;

removing the fibrous protein material from the processing surface; and

disposing the processing surface after removal of the fibrous protein material therefrom.

70. The method of claim 58, wherein the step of cutting results in creation of waste pieces of the fibrous protein material and including the further step of rolling up the processing surface to capture the waste pieces before the step of disposing.

71. The method of claim 70, wherein the step of providing comprises the step of forming the first material and the third material *in situ* on the second material.

72. A method of forming a disposable cutting surface, the method comprising the steps of:

providing a liquid absorbent material ;

forming a liquid-permeable, cut-resistant surface that can withstand cutting by a

serrated knife without substantial compromise of the first material *in situ* on the liquid absorbent material; and

providing a liquid impermeable material adjacent the liquid absorbent material.

73. The method of claim 72, wherein the step of forming comprises the step of depositing a first thermoplastic layer.

74. The method of claim 73, wherein the step of providing the liquid absorbent material comprises the step of providing a cellulosic material.

75. The method of claim 74, wherein the step of providing the liquid impermeable material comprises the step of forming a second thermoplastic layer.

76. The method of claim 75, wherein the step of depositing the first thermoplastic layer comprises the steps of extruding streams of thermoplastic onto a web of the cellulosic material and deforming the streams of thermoplastic.

77. The method of claim 76, wherein the step of deforming the streams of thermoplastic comprises the step of contacting the streams with at least one roll.

78. The method of claim 77, wherein the roll has a plurality of protrusions thereon that spread the streams of thermoplastic.

79. The method of claim 78, wherein the protrusions are diamond-shaped.

80. A processing substrate, comprising:

a first material having a liquid-permeable surface comprising a sheet of continuous film having holes formed therein;

a second material disposed adjacent the first material and having a liquid-absorbent portion; and

a third material disposed adjacent the second material and having a iquid-impermeable surface.

81. The processing substrate of claim 80, wherein the liquid absorbent portion is disposed between the liquid permeable surface and the liquid impermeable surface.

82. The processing substrate of claim 81, wherein the first material comprises thermoplastic resin.

83. The processing substrate of claim 82, wherein the thermoplastic resin is selected from the group consisting of polyolefins, polyesters, polystyrene, polyvinyl alcohol, polyvinyl chloride, nylon, polyacrylonitrile, ABS and ethylvinylacetate.

84. The processing substrate of claim 82, wherein the holes in the continuous film are formed by punching.

85. The processing substrate of claim 82, wherein the holes in the continuous film are formed by perforating.

86. The processing substrate of claim 82, wherein the second material comprises cellulosic material.

87. The processing substrate of claim 86, wherein the cellulosic material comprises tissue.

88. A cutting surface, comprising:

a first layer having a liquid-permeable, cut-resistant surface comprising a continuous film having holes formed therein;

a second layer disposed adjacent the first layer and having a liquid-absorbent portion; and

a third layer disposed adjacent the second layer and having a liquid-impermeable surface.

89. The processing substrate of claim 88, wherein the second layer is disposed between the first and third layers.

90. The processing substrate of claim 89, wherein the first layer is made of thermoplastic resin.

91. The processing substrate of claim 90, wherein the thermoplastic resin is selected from the group consisting of polyolefins, polyesters, polystyrene, polyvinyl alcohol, polyvinyl chloride, nylon, polyacrylonitrile, ABS and ethylvinylacetate.

92. The processing substrate of claim 91, wherein the holes in the continuous film are formed by punching.

93. The processing substrate of claim 91, wherein the holes in the continuous film are formed by perforating.

94. The processing substrate of claim 90, wherein the second layer is made of cellulosic material.

95. The processing substrate of claim 94, wherein the cellulosic material comprises tissue.

96. A method of forming a cutting surface, the method comprising the steps of:

providing a first material comprising a continuous sheet of thermoplastic having holes formed therein wherein the first material includes a liquid-permeable, cut-resistant surface;

providing a second material disposed adjacent the first material and having a liquid-absorbent portion; and

providing a third material disposed adjacent the second material and having a liquid-impermeable surface.

97. The method of claim 96, wherein the step of providing the second material comprises the step of providing a cellulosic material.

98. The method of claim 97, wherein the step of providing the third material comprises the step of forming a thermoplastic layer.

99. A method of processing an item, the method comprising the steps of:

providing a processing surface comprising a liquid absorbent material, a cut resistant, liquid permeable material formed *in situ* on the liquid absorbent material and a third material disposed adjacent the liquid absorbent material and having a liquid-impermeable surface;

placing the item on the processing surface;

processing the item while the item is on the processing surface;

removing the item from the processing surface; and

disposing the processing surface after removal of the item therefrom.

100. The method of claim 99, wherein the step of processing results in creation of waste pieces and including the further step of rolling up the processing surface to capture the waste pieces before the step of disposing.

FIG. 1A

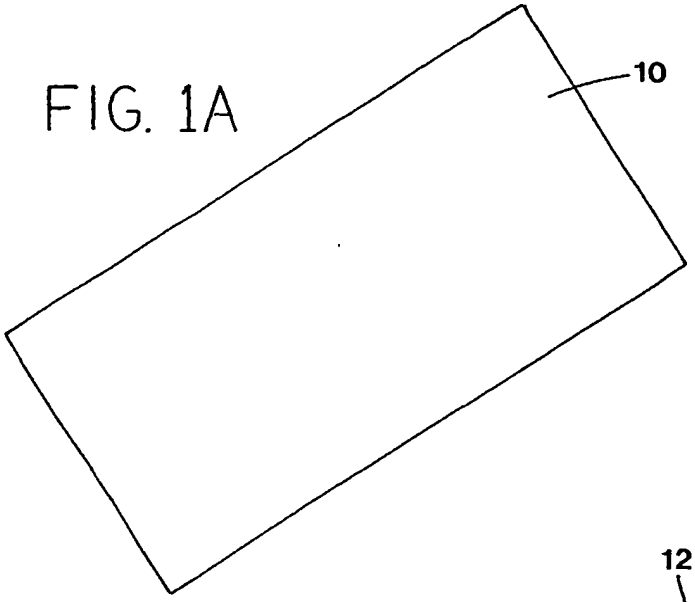
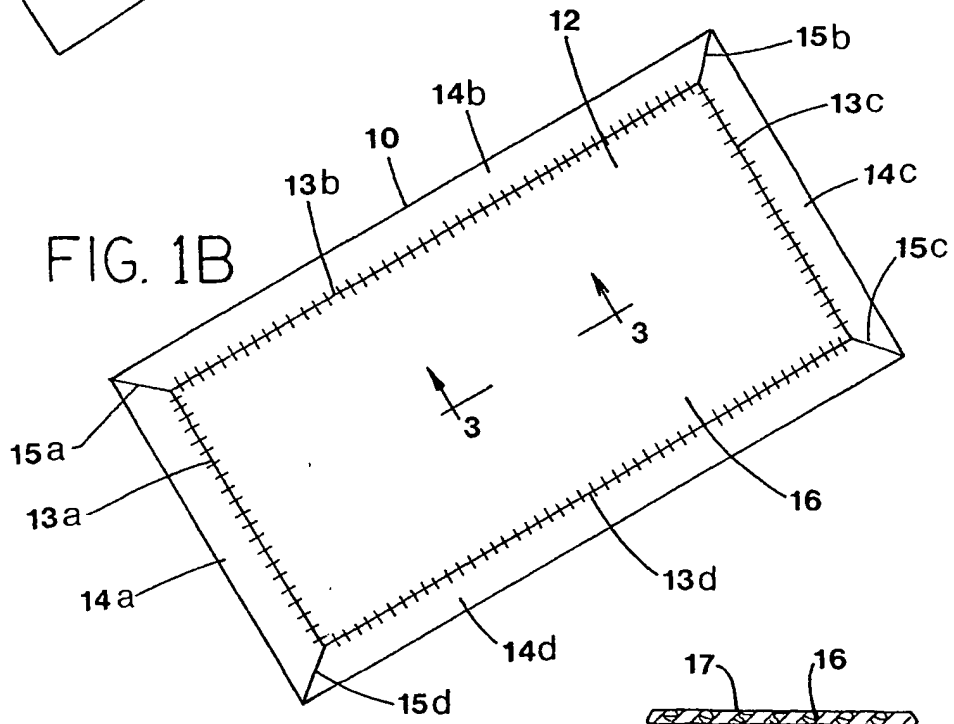


FIG. 1B



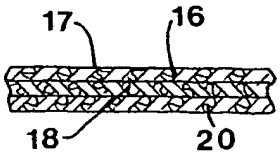


FIG. 3

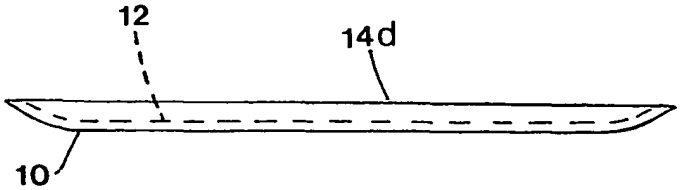


FIG. 2

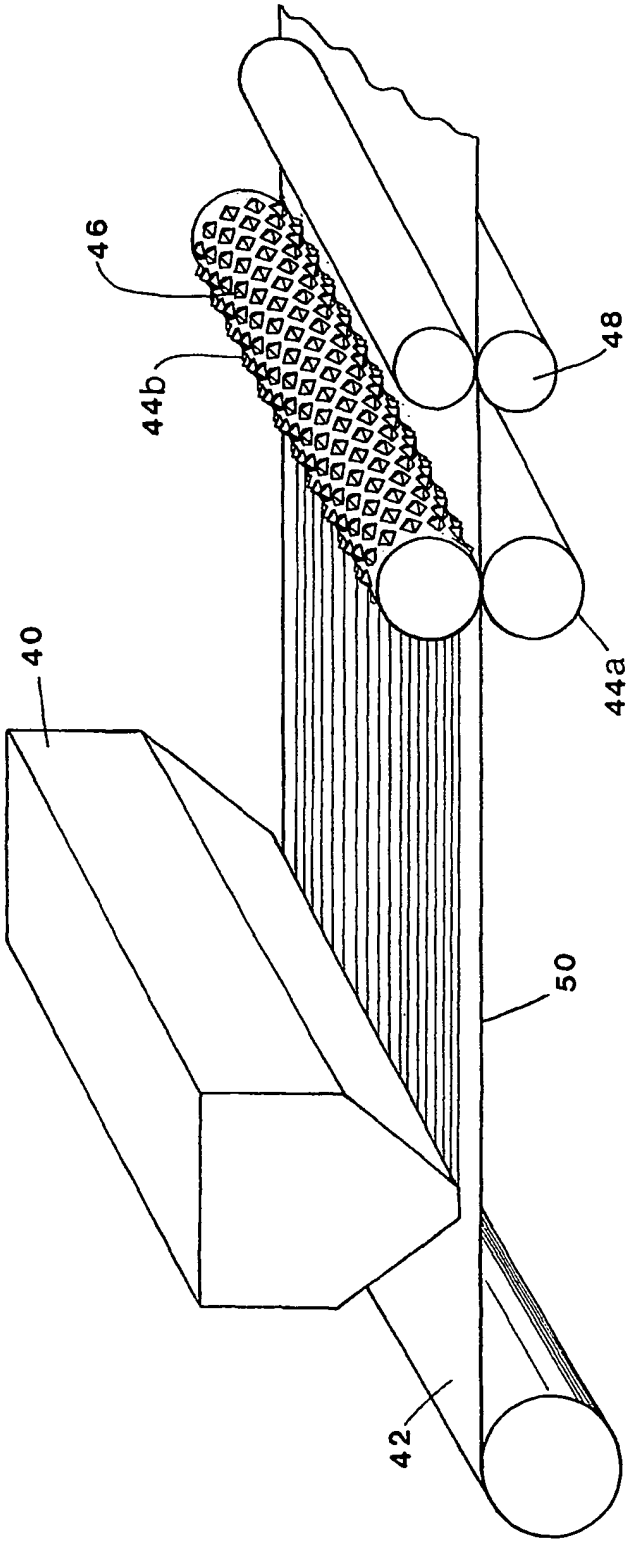


FIG. 4